WHAT IS CLAIMED IS:

1. A ridge waveguide filter having a slow-wave structure comprising an elongate hollow tube, wherein the hollow tube is define by conductive sidewall, and at least a first part of the conductive sidewall periodically protrudes along an elongate direction of the hollow tube to form a plurality of ridges projecting in the hollow tube.

2. The ridge waveguide filter of Claim 1, wherein the sidewall is fabricated from metallic materials.

3. The ridge waveguide filter of Claim 1, wherein the hollow tube includes a rectangular hollow tube.

4. The ridge waveguide filter of Claim 1, wherein the hollow tube includes a circular hollow tube.

5. The ridge waveguide filter of Claim 1, wherein the ridges are equally spaced from each other.

6. The ridge waveguide filter of Claim 1, wherein the ridges are parallel with each other.

7. The ridge waveguide filter of Claim 1, wherein each of the ridges has a bottom surface parallel with a second part of the conductive sidewall.

8. The ridge waveguide filter of Claim 8, wherein the second part of the conductive sidewall is opposite to the first part of the conductive sidewall.

9. A ridge waveguide filter having a slow structure, comprising:

an elongate hollow tube defined by a conductive sidewall;

at least one hollow ridge protruding from the conductive sidewall into the hollow tube and extending along an elongate direction of the hollow tube; and

a plurality of trenches formed in the ridge along the elongate direction.

10. The ridge waveguide filter of Claim 10, wherein the conductive sidewall includes a rectangular cross section.

11. The ridge waveguide filter of Claim 10, wherein the conductive sidewall includes a circular cross section.

12. The ridge waveguide filter of Claim 10, wherein the trenches have a depth the same as a height of the ridge.

13. The ridge waveguide filter of Claim 10, wherein the trenches are parallel to each other.

14. The ridge waveguide filter of Claim 10, wherein the trenches are equally spaced from each other.

15. A method of forming a ridge waveguide filter having a slow-wave structure, comprising:

a) forming a body portion of an elongate hollow tube, wherein the body portion has an open top;

b) providing a planar plate having a first surface and a second surface opposite to the first surface;

c) processing the first surface to form a ridge recessed from the first surface and protruding from the second surface;

d) processing the second surface to form a plurality of trenches recessed from a top surface of the ridge; and

e) covering the open top of the body portion by attached the planar plate to the body portion, wherein the second surface of the planar plate faces the body portion.

16. The method of forming the ridge waveguide filter of Claim 15, wherein step (a) comprising forming a body portion of an elongate hollow rectangular tube.

17. The method of forming the ridge waveguide filter of Claim 15, wherein step (a) comprising forming a body portion of an elongate hollow tube from conductive material.

18. The method of forming the ridge waveguide filter of Claim 17, wherein step (b) further comprising providing a conductive planar plate.

19. A method of fabricating a ridge waveguide filter having a slow-wave structure, comprising:

a) forming a conductive body portion of an elongate hollow tube, wherein the body portion has an open top;

b) providing a substrate;

c) etching the substrate to form a plurality of trenches in the substrate;

d) plating the etched substrate with a layer of conductive material; and

e) attaching the layer of conductive material with the conductive body portion.

20. The method of Claim 19, wherein step (a) comprises providing a silicon substrate.

21. The method of Claim 19, wherein step (c) comprises etching the substrate with a plurality of trenches parallel to each other along an elongate direction of the hollow tube.

22. The method of Claim 19, wherein step (d) comprises placing the layer of conductive material conformal to an etched surface profile of the substrate.

23. A method of maintaining a characteristic impedance of and reducing a size of a waveguide, comprising:

a) processing a top wall portion of the waveguide to form a ridge extending into the waveguide along an elongate direction of the waveguide; and

b) further processing the waveguide to form a plurality of ridge segments separated from each other by a gap, so as to effectively introduce a plurality of inductances between the ridge segments, which themselves capacitively couple to a bottom wall of the waveguide, such that the ridge segments and the gaps form a transmission line operating in such a way as to slow a wave propagating down the waveguide.

24. The method of Claim 23, wherein step (a) further comprising forming the ridge with a bottom surface parallel to a bottom wall portion of the waveguide.